

Drop-in alternative jet fuels: status of DoD's RDT&E, interagency initiatives, and policies

Bret Strogen, PE, PhD

SLIDES ONLY

NO SCRIPT PROVIDED

CLEARED
For Open Publication

Sep 01, 2015

Department of Defense
OFFICE OF PREPUBLICATION AND SECURITY REVIEW

August 25, 2015

NDIA Joint Service Power Exposition, Session 5, Talk #18003

Duke Energy Convention Center, Cincinnati, Ohio

***DISCLAIMER:** The views expressed are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government*

Presentation Outline

- Background Material
 - Installations vs. Operations
 - Significance of “drop-in” alternative fuel
- Recent DoD Energy/Fuel Policies
- Testing & Evaluation
 - ASTM & Services approval status
- Biofuel Production & Procurement Initiatives
 - Defense Production Act
 - Farm-to-Fleet

Alternative Fuels: DoD's Two End-user Categories

Installations & Environment

Region: Permanent bases (mostly domestic)

End-use: Mainly fleet vehicles

Alternative fuel choices: Mostly ethanol,
biodiesel, EVs, natural gas

Drivers: Compliance and cost

Market penetration: <10% of fuel use

Operational Energy

Region: Military operations (mostly overseas)

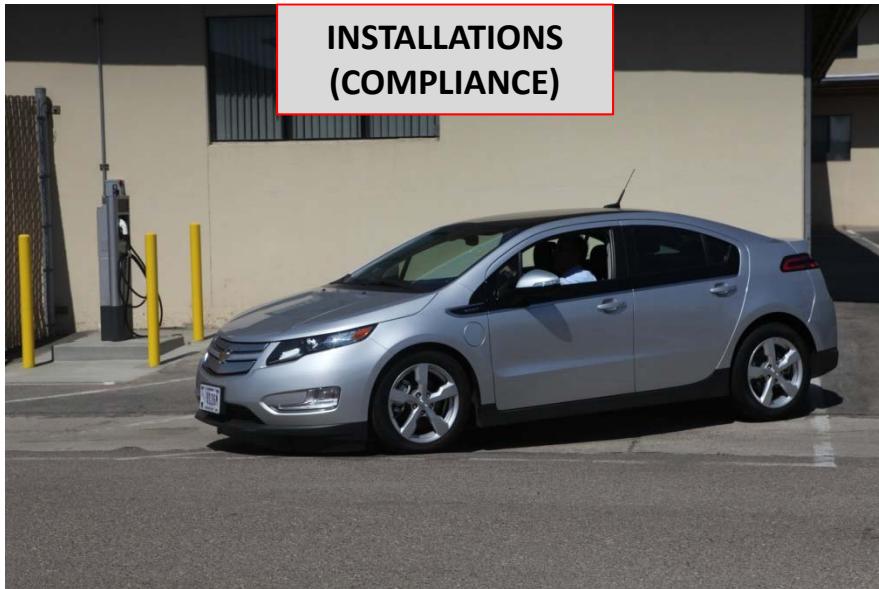
End-use: Exercises, missions, logistics, ships, jets,
helicopters, tanks, tactical vehicles, etc.

Alternative fuel choices: Drop-in jet & diesel

Drivers: Capability

Market penetration: <<1% of fuel use

INSTALLATIONS
(COMPLIANCE)



OPERATIONS
(CAPABILITY)



Military Installations follow GSA Definition of Alternative Fuel

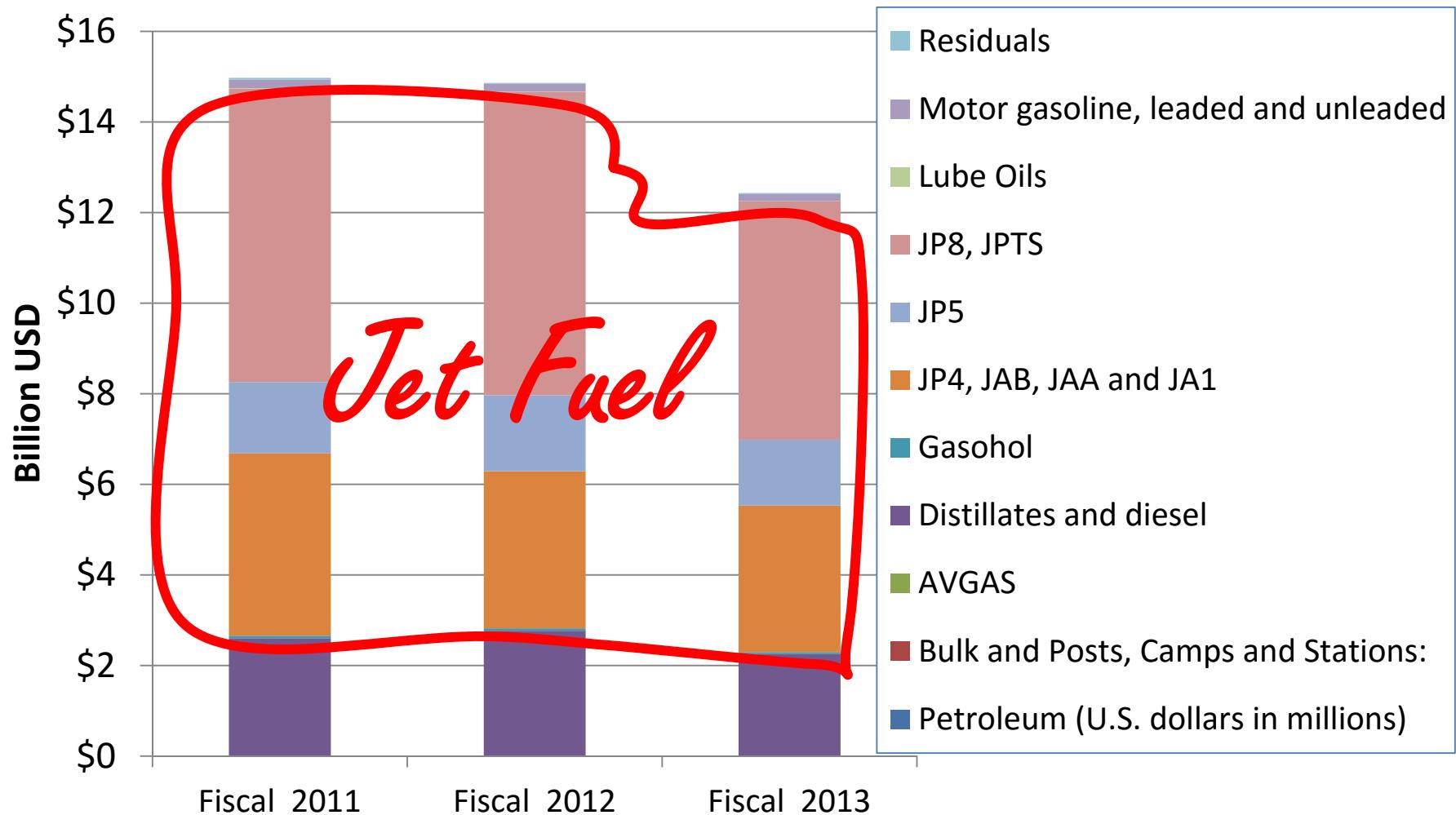
- The (updated) [Energy Policy Act of 1992](#) defined these fuels as alternative fuels:
 - Methanol, ethanol, and other alcohols
 - Blends of 85% or more of alcohol with gasoline
 - Natural gas and liquid fuels domestically produced from natural gas
 - Liquefied petroleum gas (propane)
 - Coal-derived liquid fuels
 - Hydrogen
 - Electricity
 - Fuels (other than alcohol) derived from biological materials (including pure biodiesel (B100))¹
 - P-Series.²

Why does DoD Care about “Drop-in” Alternative Fuels for Operational Platforms?

- Fuels for operations make up ~75% of DoD’s ~\$20B energy budget; majority is jet fuel, and substitutes must be *drop-in*
 - Liquid fuel infrastructure and platforms last for decades
 - Petroleum fuel-technology systems dominate military and transportation sectors
- Flexibility to procure any commercial type fuels
 - Services could be “feedstock agnostic” when buying fuels
- DoD has had some long-term interest in remote fuel production:
 - waste at remote bases
 - indigenous/locally available biomass (including algae)
 - electricity (e.g., from nuclear subs & carriers) + H₂O + CO₂
- Additional potential benefits:
 - Successful alternative fuel industry could reduce fuel prices
 - Alternative fuels could reduce life-cycle environmental impacts

Jet Fuel Dominates DoD Bulk Fuel Purchases:

(Hence, focus on “drop-in” non-petroleum jet fuel substitutes)



DoD Alternative Fuels Policy for Operational Platforms (July 2012)

- DoD's primary alternative fuels objectives:
 - ensure operational military readiness,
 - improve battlespace effectiveness,
 - promote flexibility with ability to use multiple, reliable fuel sources.
- Core elements of the policy:
 - 1) Lays out process to coordinate future testing and certification efforts.
 - 2) Sets criteria for potential field demonstrations that require use of a new fuel beyond the certification process.
 - 3) Establishes criteria for ongoing bulk fuel purchases to meet operational requirements, beyond certification and demonstration.

DoD will make bulk purchases of alternative fuels if equal or better than petroleum in: cost, compatibility, performance, and greenhouse gas emissions.

Recently Updated DoD Energy Policies Address Alternative Fuels

- *DoD Energy Policy* (DoD Directive 4180.01, April 2014)
 - It is DoD policy to enhance military capability, improve energy security, and mitigate costs in its use and management of energy. To these ends, DoD will ... [d]iversify and expand energy supplies and sources, including renewable energy sources and alternative fuels.
- *DoD Management Policy for Energy Commodities and Related Services* (DoD Instruction 4140.25, June 2015).
 - It is DoD policy that:
 - alternative fuels are obtained using the DOD's standard fuel procurement programs;
 - alternative fuels for operational purposes are purchased when cost competitive with traditional fuels and when qualified as compatible with existing equipment and infrastructure; and
 - fuel systems are qualified to use available commercial-type fuels, including alternative fuels

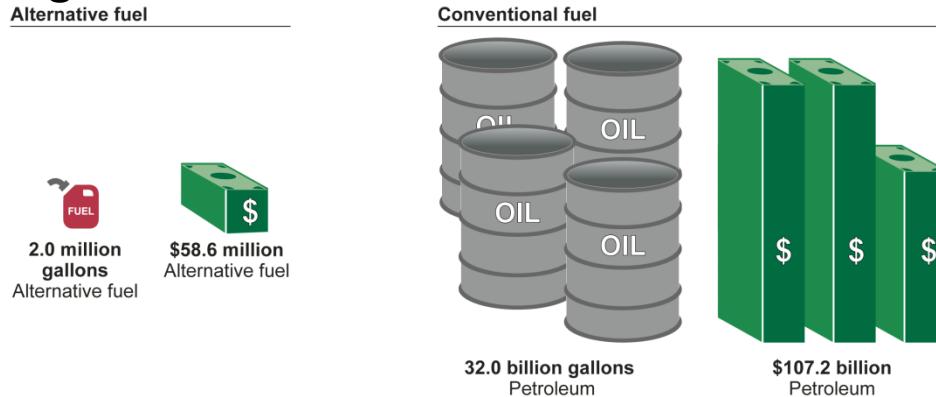
Alternative Fuels: Long-term “Goals” to Increase Use

- The Air Force and Navy have announced goals to increase alternative fuel consumption (in vehicles as well as ships, planes, and other equipment), when alternative fuels are cost-competitive with petroleum.
 - **Air Force:**
 - Increase use of cost-competitive drop-in alternative aviation fuel blends for non-contingency operations to 50% of total consumption by 2025. (*USAF Energy Strategic Plan*, March 2013)
 - **Navy:**
 - Increase alternative energy use DON-wide. By 2020, 50% of total DON energy consumption will come from alternative sources. (*U.S. Navy Strategy for Renewable Energy*, October 2012)

Alternative Fuel Purchases to Date

- To date, specific alternative fuel purchases limited to RDT&E.

Figure from GAO: Alternative & Conventional Fuel Purchases 2007-2014



US GAO. (2015). *Defense Energy: Observations on DOD's Investments in Alternative Fuels* (No. GAO-15-674). US Government Accountability Office, Washington, DC.

- For operational purposes, DoD has not paid a higher price for alternative fuels (vs. petroleum), and has not yet deliberately purchased alternative fuels in bulk.
 - DoD purchased drop-in alternative fuel blends for operational purposes in South Africa, though the quantity is unknown, as DLA Energy's contracts "only require suppliers to confirm that the fuels meet quality specifications, but typically do not require information about the type or origin of feedstocks."

Strogen, B., et al. (2014). *Feasibility of Technologies to Produce Coal-Based Fuels with Equal or Lower Greenhouse Gas Emissions than Petroleum Fuels*. Office of the Assistant Secretary of Defense for Operational Energy Plans and Programs

DoD Initiatives Related to Drop-in Alternative Fuels for Operational Purposes

MAIN AREAS OF FOCUS IN RECENT YEARS

- FUEL TESTING & EVALUATION
 - All Military Services
- FUEL PRODUCTION RESEARCH
 - Primarily DARPA & DPA
- FUEL PROCUREMENT
 - Primarily Navy (through DLA Energy)

Alternative Fuel RDT&E: Testing & Evaluation

OVERVIEW

- DoD has been evaluating new fuels for decades.
 - Recent qualification and certification efforts began in 2006.
- Military unique risk areas that are not part of commercial approval process:
 - High altitude & low-temperature operations
 - Ballistic tolerant materials
 - Non-aviation applications (e.g., JP-8 is used in ground vehicles)
- Most of DoD's initiatives now focus on testing fuels in military platforms – ensuring safe operations and procurement flexibility.
 - “Boutique” military fuel is expensive, so DoD (Defense Logistics Agency) is procuring an increasing proportion of Jet A (instead of JP-8) from refiners.
 - While saving costs, DoD must minimize potential risks as alternative fuels are integrated into commercial supplies.

Testing & Evaluation: Status of Efforts to Qualify Alternative Fuels for Use in Military Platforms

- ASTM International has approved, for commercial aviation, the use of alternative fuels produced through three pathways:
 - Fischer-Tropsch (F-T), up to 50% blends with conventional fuel
 - Hydroprocessed Esters & Fatty Acids (HEFA), up to 50% blends
 - Synthesized Iso-Paraffins (SIP), up to 10% blends
- Drop-in alternative fuels made from the F-T and HEFA processes have been tested and approved for use in
 - Navy aviation and ship platforms,
 - Air Force aviation assets,
 - Army tactical and combat ground vehicles and ground support equipment, but not yet for Army aviation assets.

US GAO. (2015). *Defense Energy: Observations on DOD's Investments in Alternative Fuels* (No. GAO-15-674). US Government Accountability Office, Washington, DC.

Alternative Fuel RDT&E: Fuel & Feedstock Production

OVERVIEW

- DoD has been advancing alternative fuel production to diversify energy supplies off and on for decades.
- Last decade's efforts were dominated by DARPA's algal and cellulosic biofuels projects (FY06-FY12).
- Most recent and ongoing project is the DPA Advanced Drop-in Biofuels Production Project (\$160M, FY12 & FY13).

President's Blueprint for a Secure Energy Future (2011)—call for interagency biofuel partnership

- Set a goal of reducing oil imports by one-third by 2025.
- Laid out an all-of-the-above energy plan to achieve that goal by, among other initiatives, speeding development of biofuels.
- Challenged the Navy, USDA, and DOE to investigate how they can work together to speed the development of drop-in (jet and diesel) biofuels.

DoD-DOE-USDA Biofuels Partnership

- **Memorandum of Understanding (MOU)**
 - March 2011: DON, DOE, and USDA entered into a MOU to “assist the development and support of a sustainable commercial biofuels industry.”
 - As part of this MOU, each agency agreed to contribute funding of ~\$170 million (for a total of ~\$510 million), and apply their core competencies, towards the biofuels initiative.
- **Two-pronged Strategy**
 - Supply Side: Support production capacity via Defense Production Act (DPA) Title III biofuels program (DoD and DOE funds).
 - Demand Side: Support purchase of biofuels by Navy via “Farm-to-Fleet” program (USDA funds to support procurement).

MOU Supply Side: DPA Title III – Advanced Drop-in Biofuel Production Project (ADBPP)

- Funding to support the design, construction, validation, qualification, and operation of domestic commercial-scale facilities capable of producing at least 10 million gallons per year neat (drop-in jet and/or diesel) biofuel.
- Phase 1 – Design (2013-2015)
 - 4 awards
 - \$20.5 million in total USG funds
 - >50% in private cost share
- Phase 2 – Construction (2015-2017)
 - 3 awards
 - \$210 million in total USG funds
 - >50% in private cost share

¹⁷ US GAO. (2015). *Defense Energy: Observations on DOD's Investments in Alternative Fuels* (No. GAO-15-674). US Government Accountability Office, Washington, DC.

MOU Demand Side: Alternative Fuel Procurement

- **Farm-to-Fleet Program (Navy-USDA Partnership):**
 - DLA Energy has solicited, on Navy's behalf, for F-76 and JP-5 containing 10-50% biofuel blends in the last two bulk fuel contracts covering the continental United States (approximately 70 million gallons per year).
 - USDA offered Commodity Credit Corporation (CCC) funds to qualifying suppliers of biofuels:
 - up to \$0.72/gallon of *neat biofuel* in the most recent (now-closed) Inland/East Coast/Gulf solicitation. (No awards were made to suppliers of biofuel blends.)
 - up to \$0.25/gallon of *blended fuels containing (10%-50%) biofuel* in open Rocky Mountain/West Coast solicitation (awards expected to be made in September 2015)



Bret Strogen, PE, PhD
bret.m.strogen.ctr@mail.mil
(703) 693-4228